Hand Lens

Fast Facts

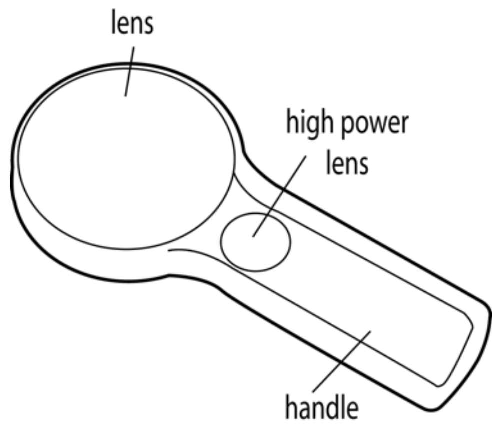
Also Known As: magnifying lens, magnifying glass, magnifier, loop (loupe)

Brief Description: A hand lens is a device with a handle and a ground or molded piece of glass, plastic or other transparent material used to make object appear larger.

Images:

Hand Lens

Hand Lens Labeled



Safe Handling: Hand lenses should be treated with care. Plastic lenses scratch easily. Glass lenses are more durable but can still be scratched. Glass lenses also add the possibility of broken glass. Broken glass should never be handled by students and only very carefully by adults. Broken glass should be disposed of in a container especially for glass. This container should be part of every science classroom.

Step-by-Step

Hold the hand lens by the handle and position the lens between your eyes and the object you are viewing. It is not necessary to close one eye.

Lenses work by bending (refracting) the light rays that pass through them. Every lens has what is called a focal length. This is the distance from the lens at which the light rays are focused to produce a clear image. If the object you are viewing through a hand lens is not focused it can be brought into focus by changing the distance between the lens and your eye. The easiest way to do this is to move the lens towards or away from your eye.

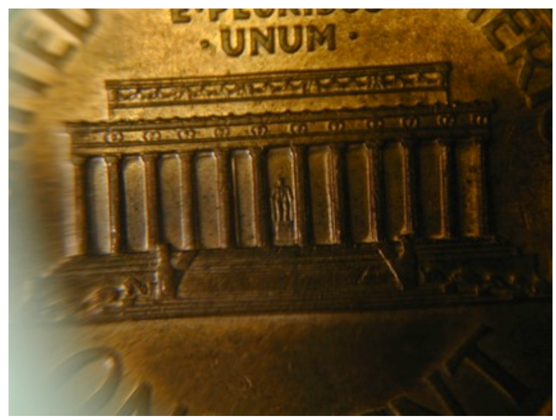
The penny is out of focus.

Moving the hand lens towards or away from your eye will bring the penny into focus.

Try it Out

The list of objects students might view with a hand lens is limitless. A couple of examples of things that are easy to get are shown below.

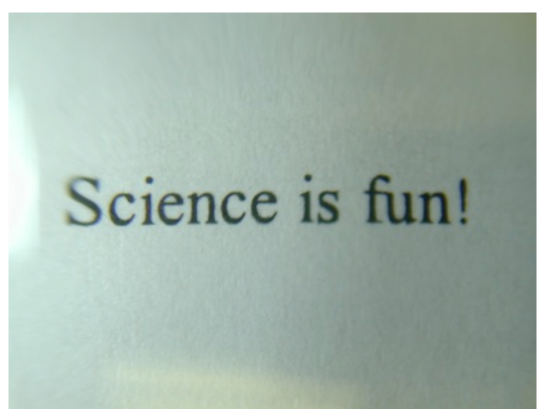
A penny viewed with a hand lens



The same penny viewed using the high power lens

Science is fun!

The words above are printed in 6 point font



The words on the left viewed with the high power lens

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a hand lens available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to observe and draw an object.*

Hot Plate

Fast Facts

Also Known as: range hot plate

Brief Description: An electric device with a metal surface for heating chemicals in a laboratory setting.

Images:

Standard Hot Plates

"Range" Hot Plate

Safe Handling: Hot plates, by definition, get hot. They can easily cause burns if not handled with care. Students often fail to realize that things placed on a hot plate heat up quickly. Anything placed on a hot plate should be handled with implements designed specifically for this task such as tongs or mitts..

Some chemicals are more dangerous when heated. Check the Materials Safety Data Sheet carefully before heating any chemicals.

Always wear safety goggles when heating any object.

Mercury thermometers should be avoided in a classroom setting, but if they are used extra caution should be taken. If a mercury thermometer breaks the mercury can quickly vaporize when it comes in contact with a hot surface. Mercury vapor is very toxic.

Any substance, even water or air, can create a danger if heated in a closed container. The pressure built up by expanding matter can cause a glass container to explode. NEVER HEAT A CLOSED OR STOPPERED CONTAINER.

Step-by-Step

Always set a hot plate on a stable, level surface such as a lab table.

Make sure the hot plate is turned off and/or set to zero or the lowest setting.

Carefully plug the hot plate into an electrical outlet.

Place the object to be heated on the hot plate.

Put on safety goggles.

Turn the hot plate on and adjust the heat setting.

Once the object begins to heat up it should, from that point on, only be handled using tongs, mitts or other appropriate safety tools.

Try it Out

The safest and most appropriate substance to heat with a hot plate in an elementary classroom is pure water or ice.

Salt water can be heated to evaporate the water and leave the salt behind. The same can be done with a solution of sugar water.

If salt water or sugar water is heated, be sure to turn off the heat and/or remove the container holding the solution BEFORE all the water has evaporated. Residual heat will continue to cause evaporation but leaving the solution on the hot plate after all the water has evaporated will result in problems.

If dry salt crystals are heated trapped air can cause them to "pop" and create tiny explosions of salt.

If sugar is heated without water present it will quickly caramelize and burn, creating smoke and an unpleasant odor as well as ruining the glassware.

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a hot plate available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to heat a substance.*

Meter Stick

Fast Facts

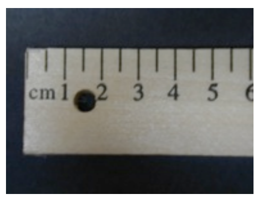
Also Known As: meter, rule

Brief Description: A meter stick is a straight-edged strip of wood, metal or plastic for measuring length. Meter sticks are commonly marked with centimeter units and sometimes have millimeter or decimeter units marked as well.

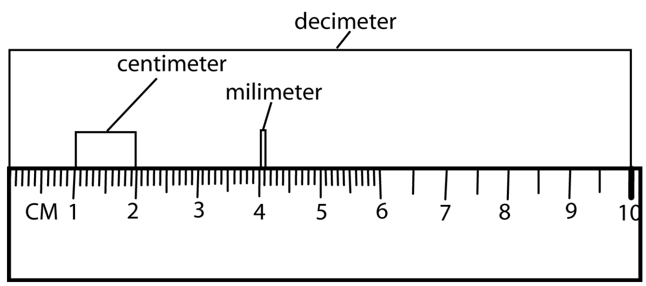
Images:

Meter Stick

Meter Stick - Close-up



Meter Stick - Labeled



Safe Handling: Meter sticks may have sharp corners, and some may have metal parts with sharp edges or corners. Care should be taken with these to avoid causing injury to oneself or others. Meter sticks will break if handled roughly or carelessly.

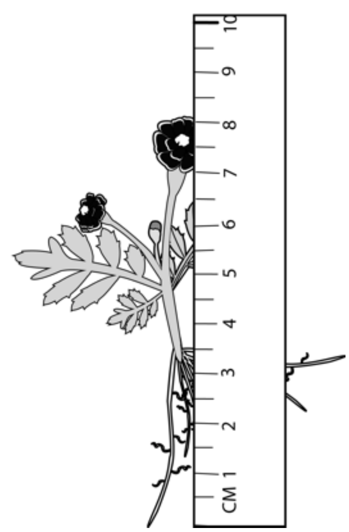
Step-by-Step

Whenever possible, the meter stick should be laid flat on a smooth surface directly alongside the object to be measured.

One end of the object should be aligned with the zero on the meter stick.

The line closest to the other end of the object represents the length of the object.

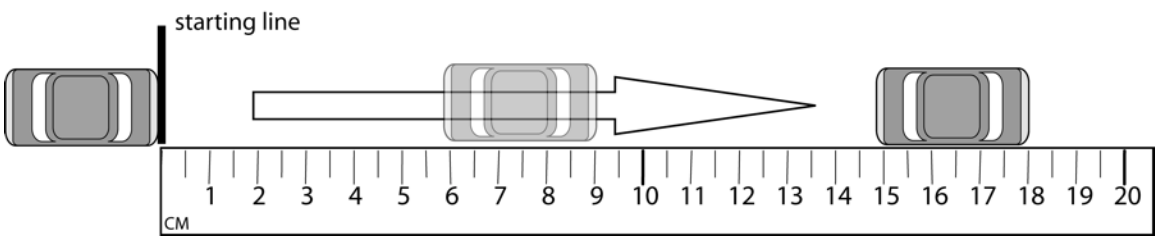
Since meter sticks often do not have millimeters, and since they are a meter long, they are generally more useful when measuring objects or distances greater than 30 centimeters.



This flower is about 8 centimeters tall.

When using a meter stick to measure the distance an object travels, it is important to choose and mark a starting point. It is also important to measure the distance traveled in reference to the same point on the object.

For example, in measuring the distance a toy car travels, you might start measuring distance from the point where the ***front end*** of the toy car passes the starting line. To determine the distance it traveled, you would measure the distance between the starting line and the ***front end*** of the car.



The car traveled 18 centimeters **not** 15 centimeters.

Meter sticks can be used to measure distances that exceed one meter. To do this the zero line on the meter stick is aligned with the starting point. The end of the meter stick (100 cm) is marked, or its position is noted by placing a finger or some object there. The meter stick is moved so that the zero line is now at the point previously occupied by the 100 cm line. This process is repeated, adding 100 centimeters or one meter each time.

Try it Out

Below is a list of objects students can measure with a metric ruler. These are objects that should be readily available, but the list can certainly be modified or expanded. For each object an approximate measurement is offered to make it easy for teachers to assess student mastery.

A standard sheet of **notebook paper** is approximately **28 cm long** and **21.5 cm wide**.
A standard **student desk** is about **45 centimeters** by **60 centimeters**.
A **student's height** will probably be **100 centimeters - 200 centimeters** (**1 – 2 meters**).

Other distances that will vary greatly but lend themselves to measurement with a meter stick:
Length (width) of classroom
Width, height or length of playground equipment
Length (width) of playground

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a meter stick available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure a distance.*

Microscope

Fast Facts

Also Known As: compound microscope, monocular microscope, stereo microscope

Brief Description: A microscope is an instrument that uses a lens or a combination of lenses to produce magnified images of small objects, especially of objects too small to be seen by the unaided eye. It is most often a light-proof tube of metal with lenses at both ends mounted above a stage that holds a slide and allows light to enter from a mirror or bulb below.

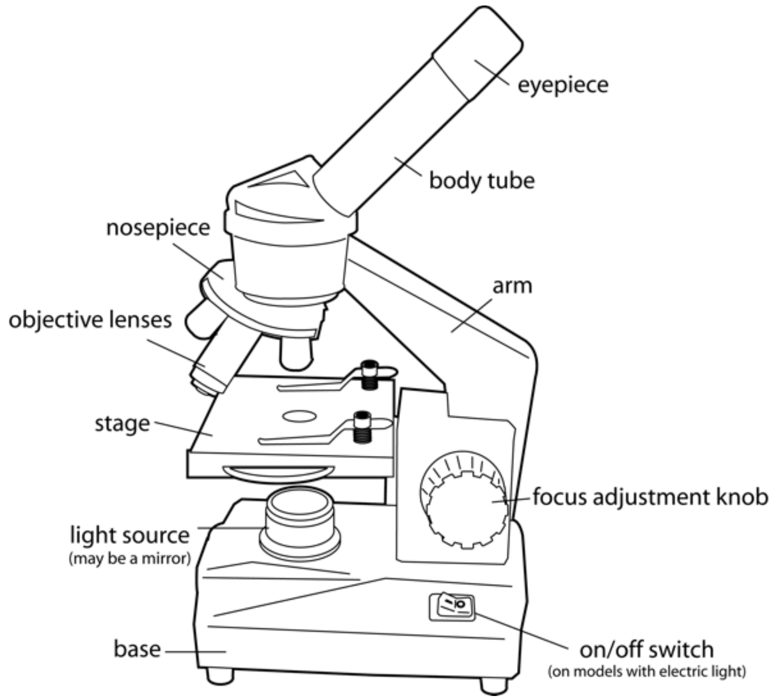
Images:

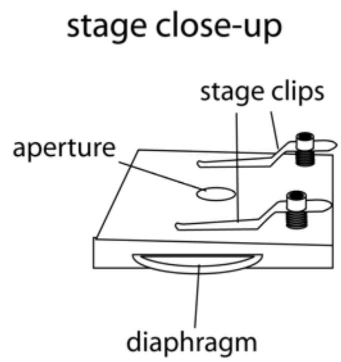
Simple Microscope

Standard (Monocular) Microscope

Stereo Microscope

Microscope – Labeled


eyepiece
body tube
nosepiece
arm
objective lenses
stage
focus adjustment knob
light source
(may be a mirror)
base
on/off switch
(on models with electric light)


stage close-up
stage clips
aperture
diaphragm

Safe Handling: Microscopes should always be carried with two hands. One hand will hold the microscope by the arm, and the other hand will support the base.

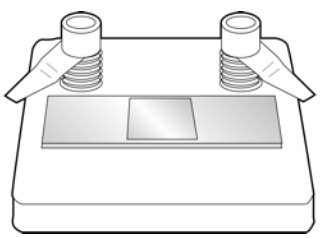
Most slides are made of glass and need to be handled carefully. Damaged slides need to be disposed of in a special container for broken glass that should be part of every science classroom.

When viewing slides, take care to begin with low power. It is possible to force the high power lens into a slide, damaging the slide, the lens or both.

Step-by-Step

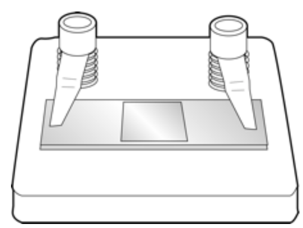
The microscope should be placed on a flat stable surface such as a desk or a table.

If the microscope has more than one objective lens, the lowest power should be used first. Swing the nosepiece around until the objective lens with the lowest power clicks into place over the stage. Objective lenses are frequently labeled with their power, e.g. 4X, 10X, 40X, etc.



Swing the stage clips outward and place the slide onto the stage with the part to be examined directly over the aperture.

Swing the stage clips back over the slide to hold it in place.



Look through the eyepiece. Most microscopes have only one eyepiece. These are known as monocular microscopes. If this is the type you are using, look through the eyepiece with your dominant (stronger) eye. Do not close the other eye. If you are using a stero microscope you will use both eyes.

Use the diaphragm to adjust the amount of light.

Use the focus knobs to adjust focus. Many microscope have both a course and a fine adjustment knob. Use the coarse adjustment knob first to get a decent image. Next use the fine adjustment knob to make the image clearer. Be very careful when using the focus adjustment knobs with a high power objective lens. This lens is the longest and is closest to the slide, and it is possible to force it directly into the slide,

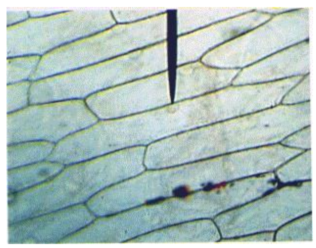
Remember to begin viewing with the lowest power. Not only is it safer, it makes it easier to find what you're seeking. Viewing under a higher power reduces your field of vision.

Try it Out

There are many commercially available prepared slides. It is a good idea, however, to allow students to prepare their own slides. Instructions for preparing wet-mount slides can be found at the end of this document. Below are some common items used to make slides and what they should look like.

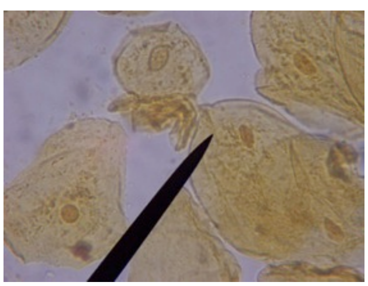
The letter "e" typed or from a newspaper (Notice that it appears to be upside down and backwards.)

Onion cells



Elodea
(Aquatic plant sold in most pet stores)

Cheek cells



Human hair

Air bubbles
(Not often an intended Target, but very common)

Many useful images are available at http://web.grcc.edu/biosci/pictdata/101contents.htm.

Assessing Mastery

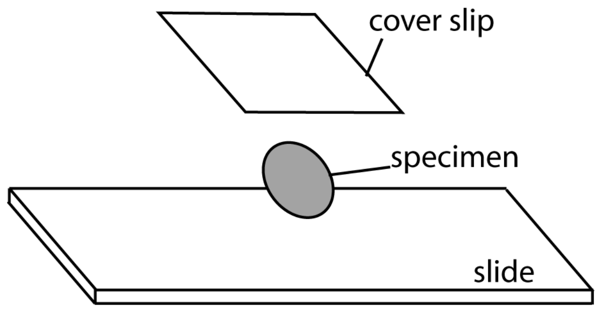
The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a microscope available and ask each student to perform the following tasks.

- *Name this tool.*

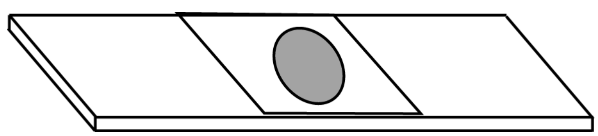
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to observe and draw an object.*

Preparing a wet-mount slide

Begin with a slide. This is a small rectangular piece of glass. Place the specimen in the center of the slide. Place a cover slip on top of the specimen. A cover slip is a thin square of glass or plastic. Great care must be used in handling cover slips as they break very easily.



The cover slip should be placed very gently on top of the specimen.



a completed slide

Adding methylene blue stain will make the cell walls and the nucleus of the cell more visible. Methylene blue, and all stains, should be handled very carefully. Not only is the stain toxic, but as its name implies, it will stain skin and clothing.

To add the stain to a slide, place a small drop of the stain at the edge of the cover slip. The stain should be drawn under the cover slip.

Specimens can be obtained easily and inexpensively.

One of the most common slides to prepare for a first attempt is a letter cut from a magazine or newspaper. When newspaper is used the student will see details, such as fibers, not visible before. The letter "e" is commonly used because an object viewed under the microscope appears upside-down and backwards, and this phenomenon is more easily seen with a letter.

Elodea is a common aquatic plant. It is sold wherever pets (fish) are sold. The leaves are usually thin enough to make a slide without any special preparation. Onion cells make good specimens. Simply cut an onion into cubes and peel off a single layer.

Cheek cells can be scraped from the inner wall of a student's cheek with a toothpick. Care must be taken that a student does not scrape too vigorously or for too long. These cells are constantly being shed and are easy to obtain.

Two-Pan Balance

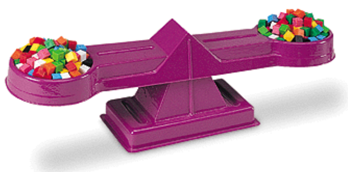
Fast Facts

Also Known As: simple balance, school balance, introductory balance, elementary balance. primary balance

Brief Description: A two-pan balance is the simplest and oldest device for measuring weight or mass. It consists of two pans that balance about a central pivot point and can be used to compare two objects placed on the pans.

Images:

Simple "Pyramid" Balance



Elementary School Balance

Balance with Weights

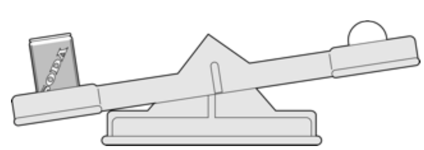
Safe Handling: Most two-pan balances are simply constructed from durable plastic and can tolerate the rough handling they may get in a classroom. Others are a little more complicated and delicate. Regardless, students should learn to handle any piece of lab equipment with care.

A balance should always be carried with two hands supporting the base. Objects, especially heavy ones, should be placed gently in the pans.

Step-by-Step

Comparing Two Objects

The simplest task that can be performed using a two-pan balance is comparing two objects. One object is placed in each pan. The pan that holds the heavier object will be lower. The pan that holds the lighter object will be higher. In other words, the object with more mass will be in the lower pan, and the object with less mass will be in the higher pan.



Technically, mass and weight are different properties. The distinction between these two concepts is beyond the scope of this document. Suffice it to say that while the concepts are different,

the terms can be used interchangeably for most practical purposes. In upper grades students can learn how and why mass is different from weight. In lower grades it is only important to use the phrases “more mass” and “less mass” alongside “heavier” and “lighter”.

The can of soda is heavier than the ball.
The ball is lighter than the can of soda.
The can of soda has more mass than the ball.
The ball has less mass than the can of soda.

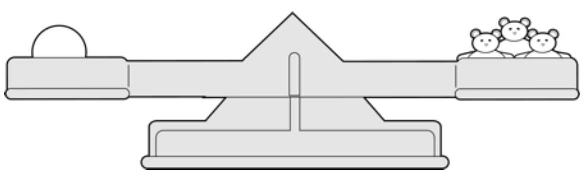
Measuring Mass with Nonstandard Units

The two-pan balance can be used to do more than simply compare two objects. It can be used to measure mass. All you need is a group of objects that have a uniform mass.

The object to be weighed (massed) is placed on one pan. While either pan can be used it is a good idea to have students use the left pan as this will prepare them for using a triple-beam balance later.

Objects of uniform mass are placed in the opposite (right) pan until the arms of the pan are perfectly balanced. Nearly all balances have a pointer/line system in their center that makes it easier to see when the two arms are level.

Any group of objects can be used on the right pan as long as they all have the same mass (weight). Paper clips and pennies are both good choices as they are easy to get and almost always have exactly the same mass. Math manipulatives such as counting cubes or bears are ideal since they are very uniform, durable, brightly colored and have a standard weight (mass).

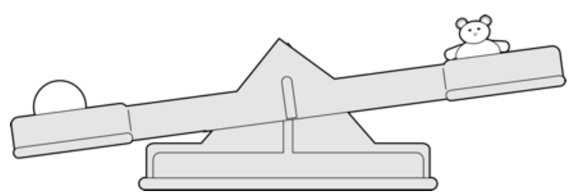


The ball is as heavy as the three bears. We could say that it has the same weight or mass as three bears. To practice the correct terminology the student could say, “The ball’s mass is equal to three bears.”

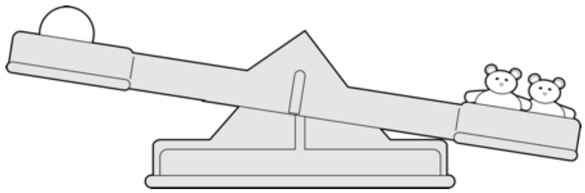
If you are using nonstandard units it is important to make sure all the objects used are exactly the same. Students using nonstandard mass units add them to the right pan until it is level with the left pan. Then they simply count up the number of objects in the right pan

Measuring Mass with Standard Units

Students using standard units can use different sized weights in the right pan. They will begin by placing the largest weights, one-by-one, in the right pan. When the right pan drops below the left pan they will remove the last weight added.

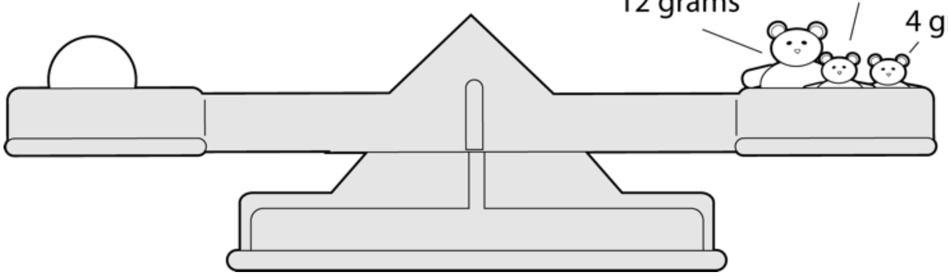


One large bear is not enough. Another needs to be added.



Two large bears are too much. One needs to be removed, and the student should begin using smaller bears.

Students repeat this process with smaller weights until the two pans are balanced. To find the mass of the object they simply add the masses of all the weights in the right pan.



The mass (weight) of the ball is equal to the sum of all the bears. 12 + 4 + 4 = 20 grams.

Try it Out

Below is a list of objects students can measure with a two-pan balance. These are objects that should be readily available, but the list can certainly be modified or expanded. For each object an approximate measurement is offered to make it easy for teachers to assess student mastery.

A **penny** has a mass of approximately **2.5 grams**.
A **can full of soda** usually has a mass just under **356 grams**.
An **unsharpened pencil** has a mass of about **7 grams**.
A **CD** has a mass of **15 grams**.
A **small paper clip** has a mass of around **0.5 grams** (half a gram).

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a two-pan balance available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure the mass of an object.*

Ruler

Fast Facts

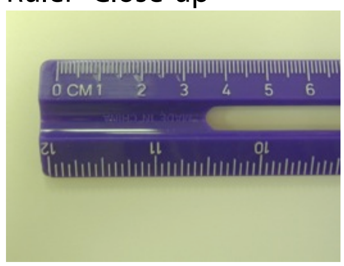
Also Known As: metric ruler, rule

Brief Description: A ruler is a straight-edged strip of wood, metal or plastic for measuring length. Rulers commonly have units in metric and standard units, but in a science classroom we use strictly the metric units.

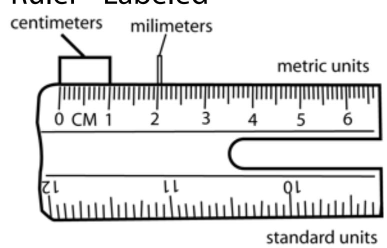
Images:

Ruler

Ruler- Close-up



Ruler - Labeled

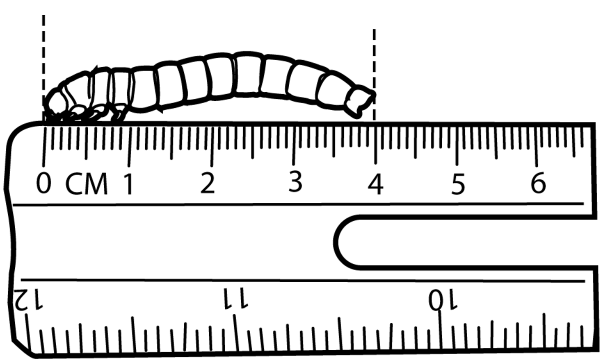


Safe Handling: Metal rulers may have sharp corners, and wooden rulers may have a metal strip with sharp edges or corners. Care should be taken with these rulers to avoid causing injury to oneself or others. Plastic rulers will break if handled roughly or carelessly.

Step-by-Step

Whenever possible the ruler should be laid flat on a smooth surface directly alongside the object to be measured.

One end of the object should be aligned with the zero on the ruler.



The line closest to the other end of the object measured represents the length of the object.

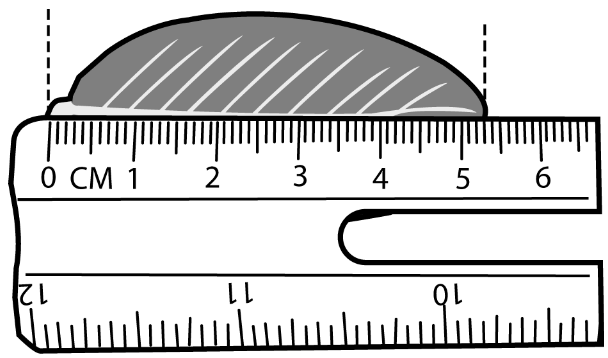
In this illustration the head of the larva has been lined up with the 0 cm line. The tail end of the larva reaches the 4 cm line. The length of this larva is about 4 centimeters. Ideally the object

measured lies straight against the ruler, but in some situations, as with this living creature, it is difficult or unadvisable to try to flatten the object being measured.

In lower grades a measurement rounded to the nearest centimeter is acceptable. In the upper grades students should measure to the nearest millimeter.

There are ten millimeters in each centimeter so each millimeter is read and expressed as one tenth (0.1) of one centimeter.

This leaf reaches the third millimeter line beyond the 5 cm line. The length of this leaf is, therefore, 5 centimeters and 3 tenths of a centimeter, or 5.3 cm.



Try it Out

Below is a list of objects students can measure with a metric ruler. These are objects that should be readily available, but the list can certainly be modified or expanded. For each object an approximate measurement is offered to make it easy for teachers to assess student mastery.

A standard sheet of **notebook paper** is approximately **28 cm long** and **21.5 cm wide**.
A **soda can** is usually about **12 cm tall** and has a **diameter** across the top of **5.4 cm**.
An **unsharpened pencil** is usually just under **19 cm long**, including the eraser.
A **CD** has a **diameter** of **12 cm**.
A **standard staple** is **1.2 cm across** and **0.6 cm tall** (if unused).

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a metric ruler available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure the length of an object.*

Thermometer

Fast Facts

Also Known As: immersion thermometer, laboratory thermometer

Brief Description: A thermometer is an instrument for measuring temperature. The thermometers we use in the classroom include a graduated glass tube with a bulb containing a liquid, typically mercury or colored alcohol,that expands and rises in the tube as the temperature increases.

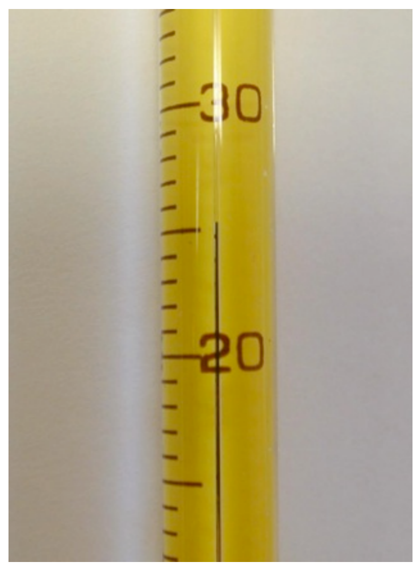
Images:

Standard Immersion Thermometer

Bulb

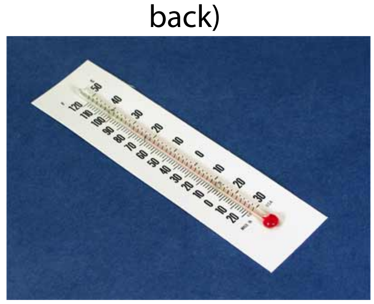
Close-up

The temperature reading on this thermometer is 25 °C



Simple Student Thermometer (metal back)

Simple Student Thermometer (plastic back)



Safe Handling: Thermometers, especially the longer laboratory thermometers, should always be carried with two hands. Never hold the bulb end of the thermometer; the heat from your hands might result in inaccurate readings.

Most thermometers are made of glass and should be handled with the care used for all glass objects. Students should never clean up broken glass, and even adults should handle broken glass carefully. Broken glass should be disposed of in a container

intended especially for glass. This type of container should be part of every science classroom.

Some thermometers contain mercury, which is extremely toxic and poses additional health and safety concerns. Classroom teachers should make every effort to replace mercury thermometers with spirit or alcohol filled thermometers as these pose a much reduced health risk. If the fluid inside a thermometer is red it is probably alcohol. If the fluid inside a thermometer appears to be grey or silver, it is probably mercury. If you have mercury thermometers in your classroom you need to obtain and familiarize yourself with the Materials Safety Data Sheet for mercury. One can be obtained online at http://www.jtbaker.com/msds/englishhtml/m1599.htm.

A thermometer should be held firmly but gently while being used. When it's not in use, place the thermometer on a flat surface where it can't roll.

If the thermometer needs to remain immersed in a substance, such as water in a beaker, and it is impractical or dangerous to hold the thermometer for an extended period, the thermometer should be held in a clamp attached to a ring stand.

Never leave a thermometer propped up against the side of a container, especially one being heated. The entire system can easily tip over.

Step-by-Step

If a thermometer is being used to take the temperature of the surrounding air, nothing special needs to be done. It is only important to avoid touching the bulb end of the thermometer since the warmth of your hands may result in an inaccurate reading.

When students measure the temperature of an object, the bulb end of the thermometer should touch the object.

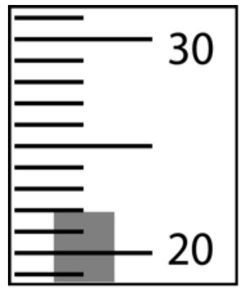
When students measure the temperature of a substance, the bulb end of the thermometer should be immersed in the substance if possible.

To read the temperature, simply note the line that the upper end of the fluid reaches. Alcohol or spirit filled thermometers are typically easier to read than mercury thermometers as the fluid is colored red and is easy to see. The thin line of fluid in a

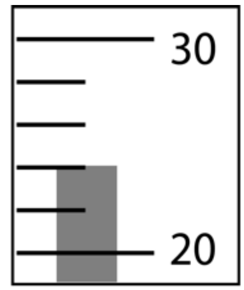
mercury thermometer can be difficult to see, especially through the glare on the surface of the glass tube. Often, changing the thermometer's angle makes it easier to read.

Two things need to be considered when reading the temperature from a thermometer, units and scale. Many thermometers have degrees marked in both Fahrenheit and Celsius (Centigrade). In a science classroom we focus on the metric (Celsius or Centigrade) temperature.

The number of lines between each numbered line also is important.



This metric thermometer should be read 22˚C.



This metric thermometer should be read 24˚C.

Students often simply count every line as one degree. They will read a thermometer as 22 degrees if the fluid reaches the second line above the 20 degree line. If there are only four lines between 20 degrees and 30 degrees, however, then each line must represent an increment of 2 degrees so the second line above 20 degrees represents 24 degrees.

Try it Out

A comfortable **room temperature** is usually **25 °C**.

Water freezes at 0° C, but when measuring the temperature of ice or **ice water** a more typical result is about **3 or 4 °C**.

Water boils at **100 °C,** and it should be possible for students to measure this with some degree of accuracy.

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a thermometer available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure the temperature of an object or substance.*

Timing Device

Fast Facts

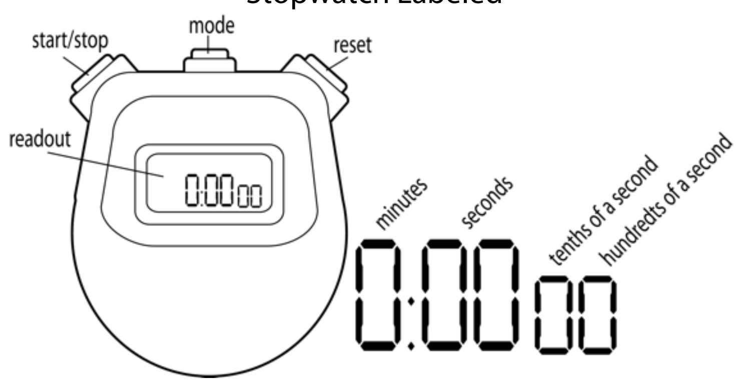
Also Known As: timer, stopwatch

Brief Description: A timing device is a piece of equipment, usually electronic, that is used to measure an exact duration of time. It can be instantly started and stopped by pushing a button.

Images:

Simple Student Timer

Stopwatch Labeled



Safe Handling: Most stopwatches are electronic devices and need to be handled with care. They can be damaged if they are dropped or handled roughly.

Step-by-Step

Many timing devices have no on/off switch. They are either on all the time or can be activated simply by pressing any button.

Stopwatch "modes"

Many stopwatches have multiple "modes" and can serve as clocks, countdown timers, etc. This type of stopwatch can't be used as a timer unless it is set to the timer mode. This can be done by pressing the mode button to toggle through the various modes.

Sometimes students have difficulty with stopwatches because they try to use them without setting them in the proper mode. For this reason a simple student timer is a better choice for a timing device unless the other modes are going to be used. If a

stopwatch with multiple modes is used, students need to be instructed in how to set the proper mode.

Measuring with a Timing Device

The first step in using a timing device is to reset it. There is usually a button labeled "reset" just for this purpose . When the timing device is reset properly the readout will be all zeros.

0:00 00

This is a readout of a timing device that has been properly reset.

When the timing device is in the proper mode and correctly reset, using it is simple.

Press the start/stop button at the beginning of the event you wish to time. Press this button again at the end of the event. The readout now displays the elapsed time.

After recording the measurement, press the reset button to clear the display and return it to zero. Now another time measurement can be made.

2:12 03	0:10 52	0:07 40	0:00 03
Elapsed time: 2 minutes 12.03 seconds	Elapsed time: 10.52 seconds	Elapsed time: 7.4 seconds	Elapsed time: 0.03 seconds

Try it Out

Below is a list of events students can time with a timing device. These are events that should be easy to recreate in a classroom, but the list can certainly be modified or expanded. For each event an approximate time is offered to make it easy for teachers to assess student mastery.

The time it takes an object to **fall one meter** is about **0.45 seconds**.
A reasonable time for **10 heartbeats** for someone at rest is **6.7 - 10 seconds**.
An **egg timer** usually has a set time of **3 minutes** or **180 seconds**.
An old board game may yield a **sand timer**. Times are **variable**.

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a timing device available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure the time of an event.*

Triple-beam Balance

Fast Facts

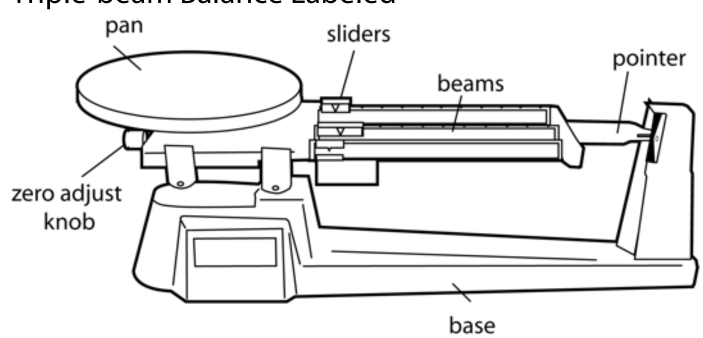
Also Known As: triple-beam balance scale

Brief Description: A triple-beam balance is a device for measuring mass. It has a single pan where the object to be massed is placed. Three sliders are moved back and forth on three beams. Each slider indicates part of the object's mass. By adding up what the three sliders indicate, we find the object's total mass.

Images:

Triple-beam balance

Triple-beam Balance Labeled



Safe Handling: Triple-beam balances should always be carried with two hands. One hand will hold the beams, keeping them from bouncing up and down, and the other hand will support the base.

Objects, especially heavy objects, should be placed carefully on the pan. The sliders should be adjusted slowly and carefully.

Step-by-Step

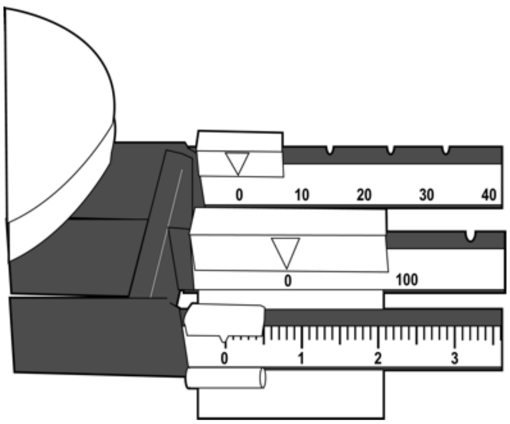
The triple-beam balance should be placed on a flat, level surface, such as a lab table.

The first step in using a triple-beam balance is to move all the sliders to their zero (0) positions on the leftmost side of their bar.

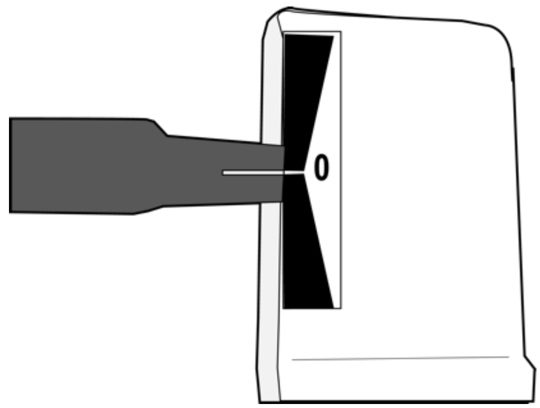
With the sliders in this position the pointer on the right should be carefully aligned with the zero line.

If the pointer is not perfectly aligned with the zero line, you can adjust it by turning the zero adjust knob located just below the pan.

All the sliders are moved to their zero positions.



The pointer on the right is now aligned with zero.



When the scale is zeroed, gently place the object to be massed on the center of the pan. Look at the pointer on the right. The pointer on the right will now point to a spot above the zero line. NOTE: When checking the pointer, ALWAYS wait until it has stopped moving.

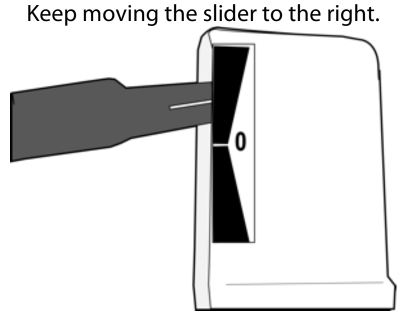
Follow the steps below for most objects.

Move the largest (100 gram) slider one notch to the right. This slider should always be moved until it comes to rest in a notch with its pointer directly over a number, never in between.

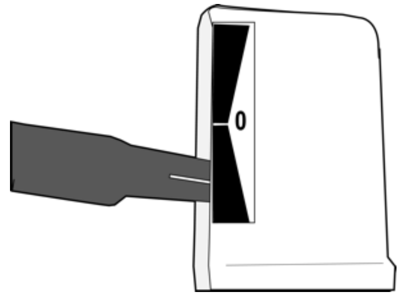
If the pointer on the right remains above the zero line, you should keep moving the slider, notch-by-notch, to the right.

When the pointer drops below the zero line, move

Keep moving the slider to the right.



Move the slider back one position to the left.



the slider one notch to the left to its previous position. The pointer will probably come to rest at a position above the zero line.

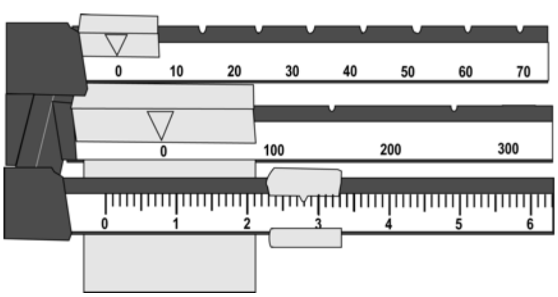
Repeat this procedure for the medium-sized (10 gram) slider.

Move the slider notch-by-notch to the right until the pointer drops below the zero line. When this happens, move the slider to its previous position, one notch to the left.
This slider should always be moved until it comes to rest in a notch with its pointer directly over a number, never in between.

After you have followed the steps above to put the 100 gram slider and the 10 gram slider in the appropriate positions, you will gently slide the smallest slider to the right. This slider has no notches and slides freely. Care should be taken because you can easily bump the beams while moving this slider and cause them to sway.

Move the smallest slider until the pointer on the right comes to rest exactly at the zero line.

The mass of the object on the pan is the sum of the masses indicated by all three sliders. If the 100 gram and/or the 10 gram slider are at the zero positions, they are ignored in this calculation.

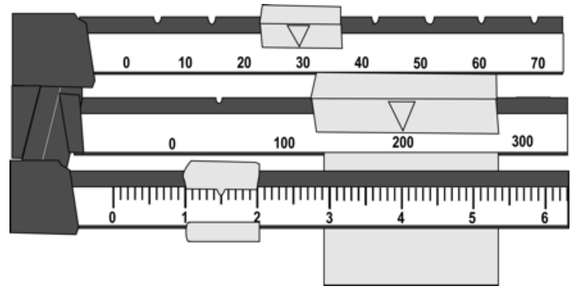


In the first example the 100 gram and 10 gram sliders are at their zero positions. The smallest slider is pointing to the eighth line after the 2 gram line. There are ten lines between each gram line. Each one represents one tenth of one gram.

The mass indicated is 2.8 grams.

In the second example the 100 gram slider is at the 200 gram position, the 10 gram slider is at the 30 gram position and the smallest slider is at the fifth line after the 1 gram line. This represents 1.5 grams.

The total mass indicated is 231.5 grams.



The steps above will work for any object, no matter what the mass, as long as it does not exceed the upper limit of the balance (usually 610 grams).

Once you are familiar with the metric units of mass you may be able to speed up the process by eliminating steps. For example, if you are measuring the mass of a pencil, an object with a mass well below 100 grams, you may skip the step of moving the 100 gram slider to the first notch and then returning it to zero when this proves to be too much.

Similarly, you do not need to move the 10 gram slider when you know that the mass of the object is well below 10 grams.

Students, however, should be encouraged to follow the steps exactly as explained above. Repeating this process will serve to build a working understanding of the tool, and the metric system mass units.

Try it Out

Below is a list of objects students can measure with a triple-beam balance. These are objects that should be readily available, but the list can certainly be modified or expanded. For each object an approximate measurement is offered to make it easy for teachers to assess student mastery.

A **penny** has a mass of approximately **2.5 grams**.
A **can full of soda** usually has a mass just under **356 grams**.
An **unsharpened pencil** has a mass of about **7 grams**.
A **CD** has a mass of **15 grams**.
A **small paper clip** has a mass of around **0.5 grams** (half a gram).

Assessing Mastery

The best way to assess student mastery of science tools is individually and hands on. Ideally a teacher would have a triple-beam available and ask each student to perform the following tasks.

- *Name this tool.*
- *Demonstrate how to safely carry (handle) this tool.*
- *Describe how this tool is used.*
- *Use this tool to measure the mass of an object.*